Regression

I. **Motivation**

In this experiment we perform polynomial fitting for a given 1-d and 2-d data.Both least squares and ridge regression is performed. First we train the model with training data and then tune the hyper-parameters(polynomial degree and regularisation parameter) with the development data.

II. **1-D data**

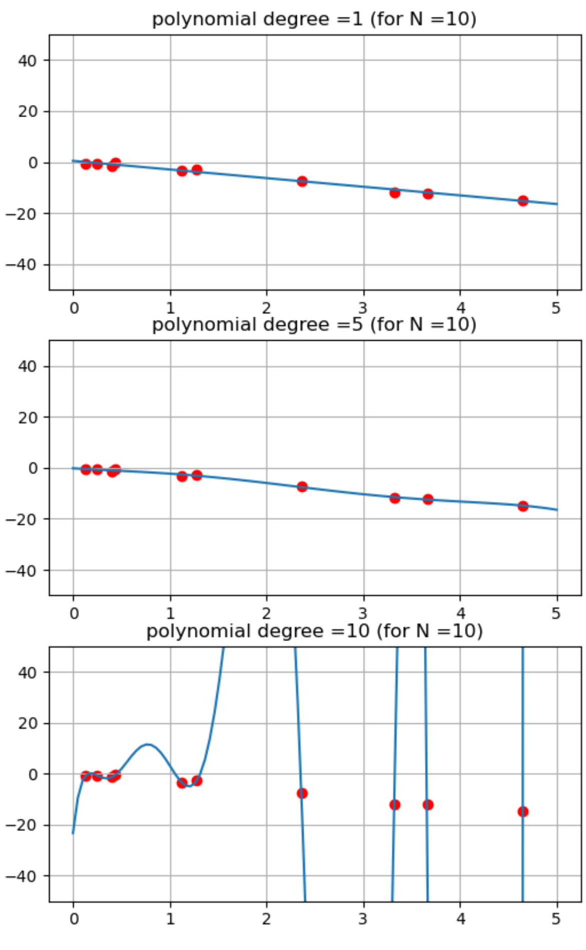


Fig. 1. *For* 10 *data points*

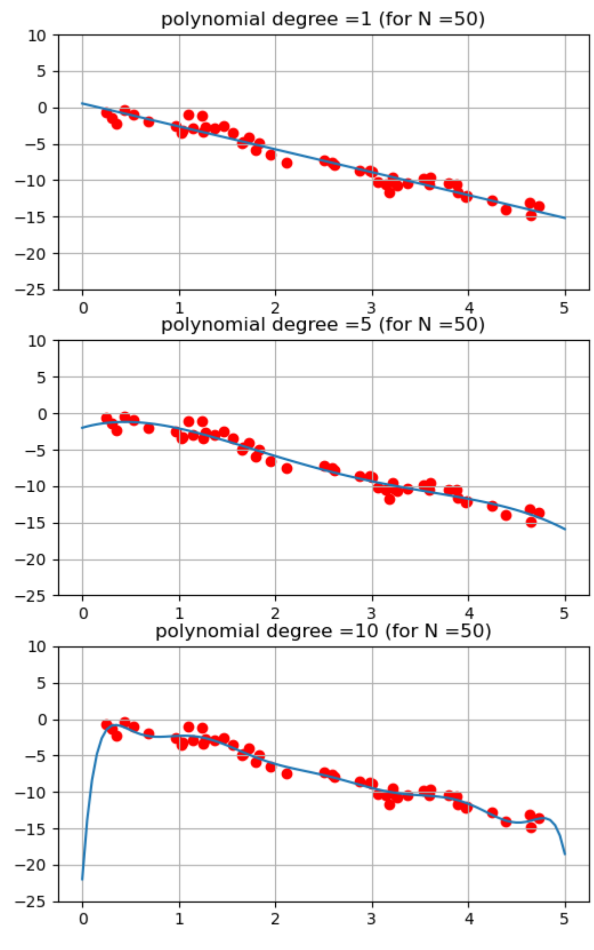
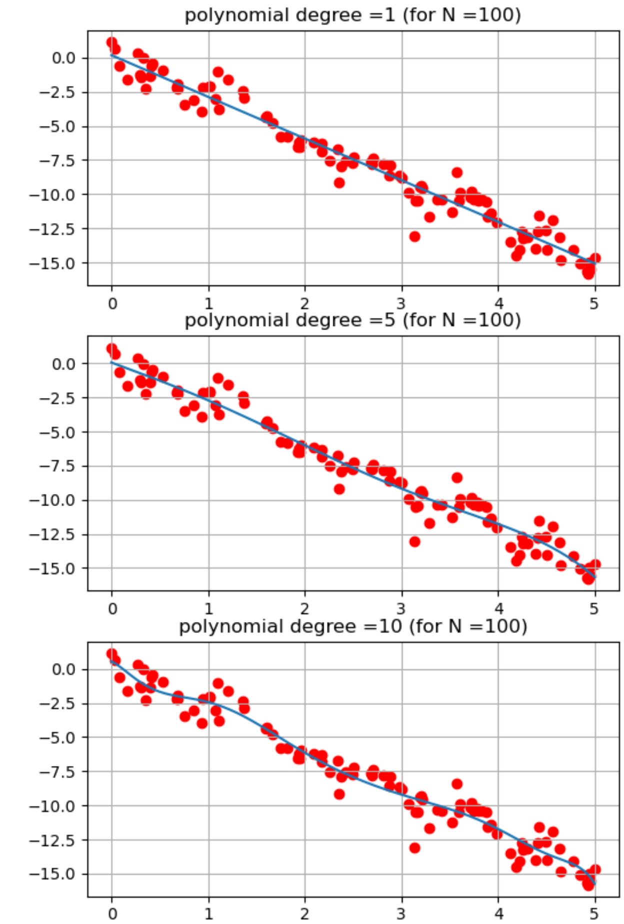


Fig. 2. *For* 50 *data points*

Inferences from Fig 1-4:

1.With increasing polynomial degree or model complexity, we observe over-fitting.

2.For the same model complexity, increasing the number of data points results in reduction of the over-fitting problem.



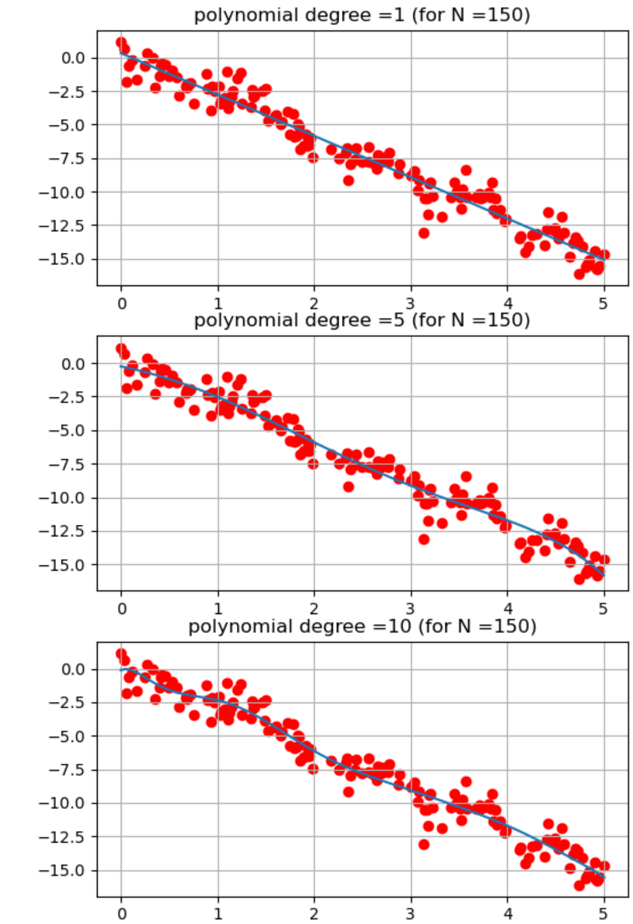


Fig. 3. *For* 100 *data points*

Fig. 4. *For* 150 *data points*

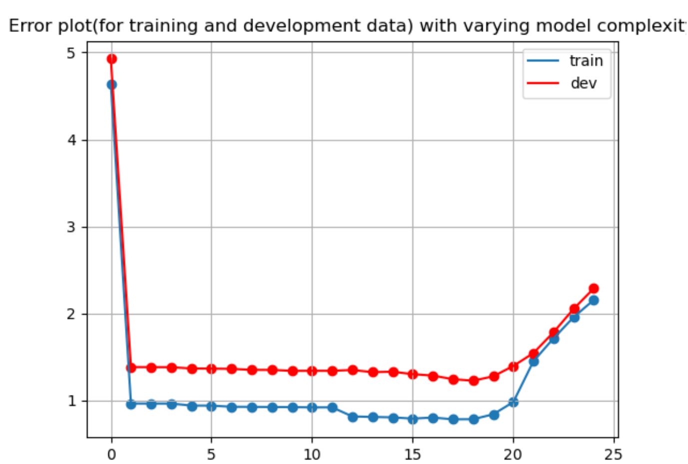


Fig. 5. *Error plot*

We have optimal degree as 18. Let us try ridge regression for this model.

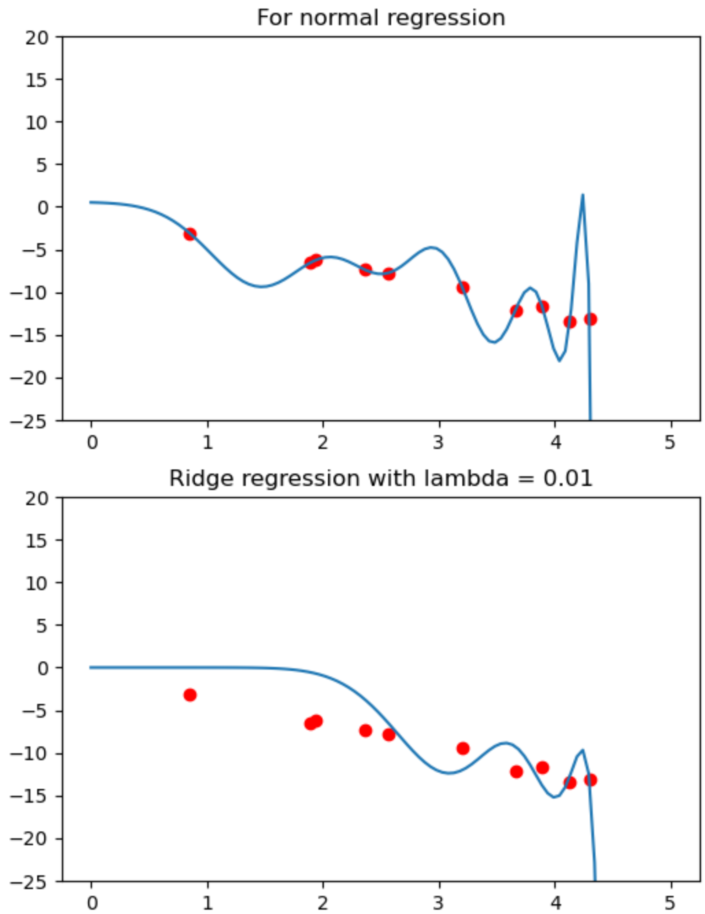


Fig. 6. *Ridge regression*

From fig-6, we can observe that by adopting ridge regression, over-fitting is reduced.

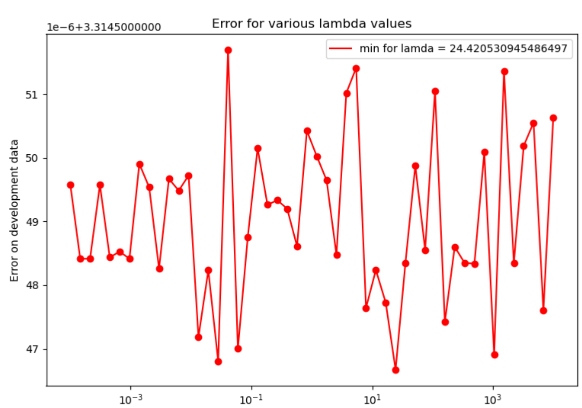
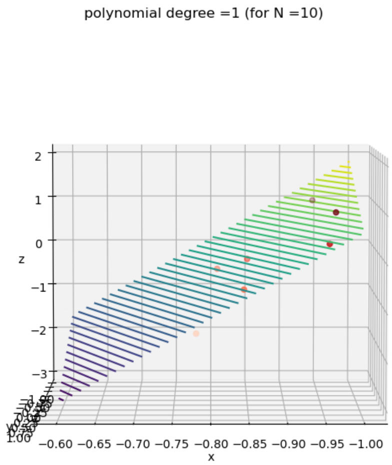
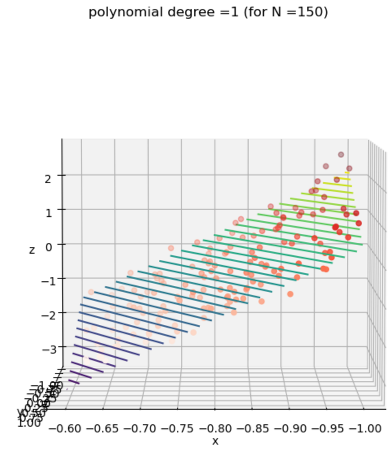
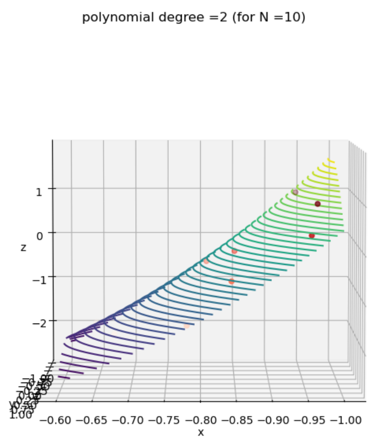


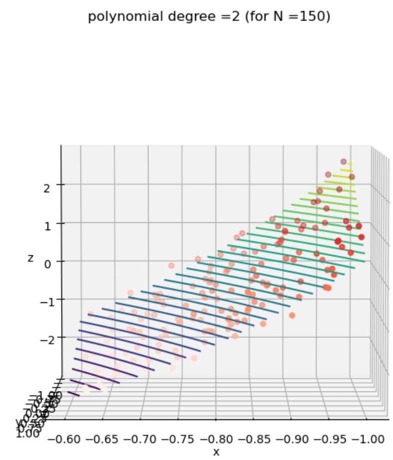
Fig. 7. *Finding optimal Lambda*

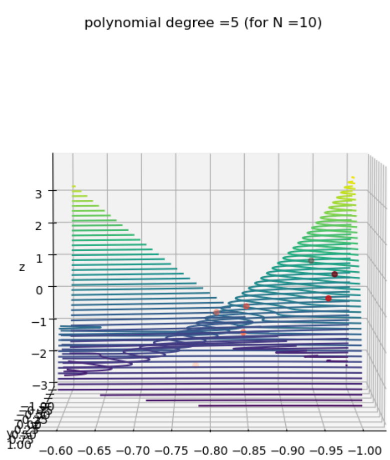
III. **2-D data**

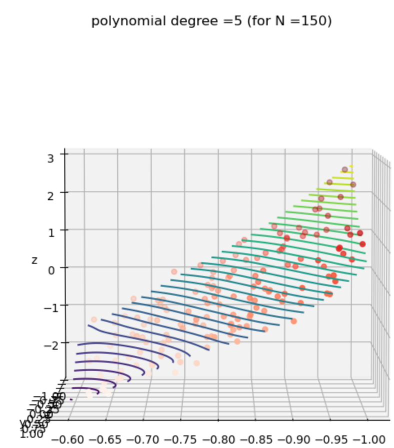












Same inferences as in the 1-d case apply for the above figures too. Increasing model complexity reinforces over-fitting. For the same model complexity, increasing the number of data points reduces over-fitting.

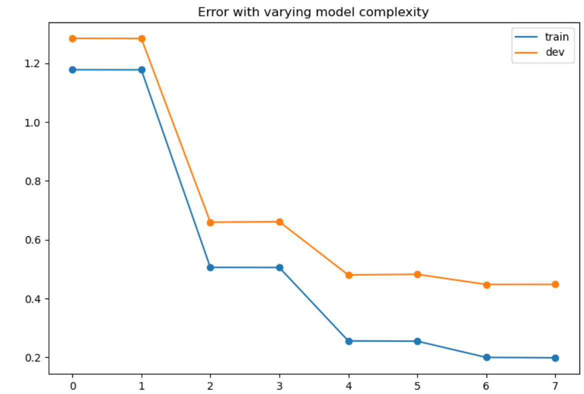


Fig. 8. *Error plot*

We have optimal degree=6 or 7. Applying ridge regression on the model with degree=7.

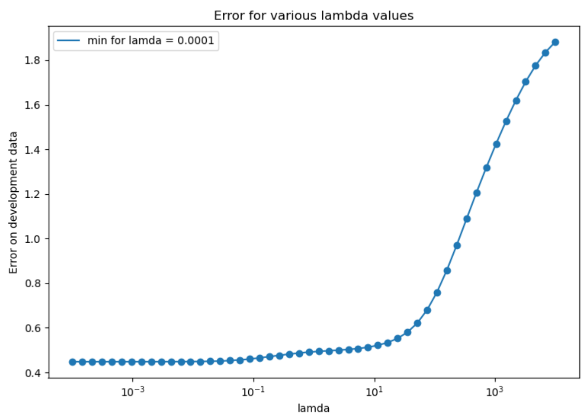


Fig. 9. *Finding optimal Lambda*